Flora W. Patterson

Irish Potato Diseases.

By J. B. S. Norton

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THE MARYLAND
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BULLETIN No. 108. APRIL, 1906.

IRISH POTATO DISEASES.

J. B. S. NORTON.

This bulletin is prepared to meet a demand for information on Irish potato diseases. The matter contained in it is taken from observations on potato diseases in this State, compared with previous work at this Experiment Station and of investigators in many other places. Especially has the work of the New York and Vermont Experiment Stations, and of the United States Department of Agriculture, been used in this treatise, which endeavors to give a brief, but full account of health and disease in the Irish potato, as related to Maryland conditions.

GENERAL CONDITIONS OF HEALTH.

Considered from the farmers' standpoint the potato plant is a machine for the production of starch, the principal constituent of the potato, together with the small amount of other substances combined with it in these enlarged under-ground stems, which we use as food. The raw material for the potato substance comes from the soil water, taken up by the roots and the gases of the air. While the sunshine and other conditions are favorable these substances are organized in the leaves, and gradually pass downward, and accumulate as starch below ground. Since such important work is done by the slender fibrous roots and the expanse of leaves exposed to the sun, the necessity of keeping these organs in good working condition is easily seen. And theoretically one might say that the more water passed through the plant from the roots, and the more sunshine received by the leaves, the more potatoes produced.

The ideal conditions for healthy growth are loose, rich, well-drained, but moisture-retaining soil of moderate coolness, rich in humus, and used in rotation with legumes. Heavy soils are not so good as light and need to have careful management. Constant moisture is the first consideration, but wet soil is equally as fatal to good growth as drought.

Rapid and constant growth gives the best quantity and flavor, though the latter varies with the soil. And the fundamental conditions must be kept up by proper cultivation, especially in the critical period in the life of the potato plant, just after the blossoms appear, when the strength is going into the formation of tubers. If the leaves can be kept healthy then, the life can be prolonged many weeks, and the yield correspondingly increased.

SEED WITH REFERENCE TO HEALTH.

After considering suitability for desired use in earliness, production and quality, the variety planted should be selected for resistance to drought, disease, insects, etc. And if it is desirable to grow one's own seed each season, the stronger, more productive and resistant plants should be picked out for seed, thus keeping up or improving the vigor of the stock. The vigor and health of the plant, which bore the seed tubers, has more to do with their success than the size of the tubers used for seed, or how they are cut.

Partly rotten potatoes or those showing any imperfections, indicating lack of vitality, should never be planted, as they are apt to communicate diseases to those that grow from them, and the cleanest, most healthy-looking seed possible should be used. One poor potato saved by planting it, is usually equivalent to throwing away a whole hill.

The weakening of the seed by too early sprouting has to be carefully guarded against, and may be done by careful storing, or by the use of northern seed. The object of the starch in the potato is to feed the young plants until they can get well-rooted, and they must suffer if it is exhausted by sprouts that are lost before planting. The cut seed may be injured by drying out, or heating, if kept more than ten days before planting. The partly dried pieces withstand rot better if planted in wet soil.

As the country becomes older, parasitic diseases and insects multiply. While in the great potato lands of the West, the plant grows luxuriantly, and is but little injured by blight or insects; here these often cause the loss of one-half of what the land would produce without them. And we have become so used to this loss that we do not see the damage, and count this half crop a full crop. The estimated loss from potato diseases in Maryland in 1904 was fifteen per cent. of the crop, and when, as statistics show, our average yield per acre is only seventy bushels, when hundreds of bushels are possible, it is of great importance that something should be done to increase the yield.

There are several different diseases caused by different germs or fungi. These are often confused and though usually distinguished as blight, rot and scab, there are several kinds of blight, also of rot and

FIG. 1.—ENTIRE HEALTHY POTATO PLANT (COPY, AFTER COBURN).

scab; each due to a different cause, and often needing entirely different treatment. The following pages gives some account of the diseases most common here.

SCAB.

The diseased condition known as scab causing roughened, scabby surfaces on the tubers, is mostly caused by a minute parasitic fungus, *Oospora scabies.* The fungus also lives in the soil from year to year. Alkaline conditions of the soil favor the growth of the scab fungus, so that lime and fresh stable manure, though valuable in increasing yield, are to be used with caution and, perhaps, are better applied to the previous crop. Lime also favors rot. If the soil to be planted is infected with scab, some green manuring might be sown in the fall, and turned under in the spring, to give acidity to the soil. Experiments in New York, however, failed to show beneficial results from green manuring to reduce scab.

FIG. 2.—SCAB ON POTATOES. (PHOTO. BY F. H. BLODGETT).

If seed potatoes free from scab cannot be had for planting, the seed can be disinfected before planting, by the use of either of the following methods; then if planted in scab-free land, the resulting crop will be practically free from the disease. The seed potatoes may contain scab germs though they appear perfectly smooth:

1. Two ounces of corrosive sublimate, dissolved in hot water and diluted with cold water to fifteen gallons. Suspend the previously washed uncut potatoes in a coarse sack in this solution for one and a half hours, using a wooden vessel as it acts on metals. This substance is very poisonous and the treated potatoes should not be eaten by anything. After soaking the potatoes are dried, cut and planted as usual.

2. Mix eight ounces (one-half pint) of commercial formalin (40 per cent.) with fifteen gallons of water, and use as the other

solution, but soak for two hours. Formalin is poisonous, but not so dangerous as corrosive sublimate; it also soon evaporates, and does not remain on the tubers as the sublimate does.

Either of these may somewhat retard the germination, and will injure the sprouts that have already started. Fifteen gallons is enough to disinfect twenty to twenty-five bushels. Of course, if the seed is planted in scabby land, the treatment will lose most of its efficiency.

Rolling the cut potatoes in sulfur, before planting, has also been used to control the scab, but is more expensive than the solutions, and is often of little value. The sulfur helps the cut pieces to keep longer, and prevents rotting in prolonged wet weather after planting. Also scattering sulfur in the rows is used by some to destroy the scab germs in the soil, but usually it does little good. Also dipping in Bordeaux mixture has been used.

In Vermont formaldehyde gas has been used with as good success as the liquid formalin to control scab. Its use is often more convenient.

Certain varieties as Cambridge Russett in particular, and also Carmen No. 3, American Giant, Sir Walter Raleigh, Irish Cobbler, Scab Proof and Aurora, are recommended as resistant to scab.

There are several less common scab diseases caused by other fungi and bacteria.

RHIZOCTONIA.

Small brown bodies not easily removed by washing often seen on potato tubers are caused by a fungus, Rhizoctonia or Corticium. As a rule they do not seem to cause much damage. But in Ohio a disease called "rosette," causing stunted growth and premature death of the potato plant, is ascribed to this fungus, and in Colorado a trouble called "little potatoes," is found associated with this fungus, which there also attacks the main stem of the plant near the surface of the ground.

The formalin treatment given for scab has been recommended for this; also the planting of clean, well-formed tubers.

DRY ROT.

This disease is caused by a fungus, *Fusarium oxysporium*, which growing in the stem causes the plants to gradually dry up and die. The disease is indicated by the lighter colored and more or less rolled up leaves. When dug the potatoes may appear sound, but internally show black or brown streaks, and later are destroyed at least at one end by the dry rot.

The fungus may remain in the soil for a long time, and badly affected land may have to be abandoned for potato growing for several years. The affected tubers should not be used for seed.

BROWN ROT, BACTERIAL WILT OR WET ROT.

This disease is caused by bacteria (*Bacillus solanacearum*), which are introduced into the plant through the bites of the Colorado beetle, flea-beetles, etc., and multiplying cause the leaves and stems to wilt and shrivel and working down into the tubers cause a wet rot. The same germ attacks egg plant, and causes the Southern blight of tomato, so destructive in the southern part of Maryland.

Very thorough and persistent spraying, using Bordeaux mixture with arsenites to prevent the action of the insects, such as flea-beetles and the common potato bugs, which scatter the germ, and to kill the exposed bacteria themselves, is the best treatment, although not perfectly effective. The affected tubers should be dug early, and if stored they must be kept in a cool, dry place to keep back the rot. In planting avoid land that has recently borne tomatoes, potatoes, or egg plants affected with this disease.

Soft rot or wet rot may develop in potatoes kept in moist and warm places, through the action of various bacteria and fungi. A large percentage of the crop is often lost from wet weather before digging time. This might be obviated by early digging, but there is also danger of rot if dug early and stored, unless some cooling is available. In handling as much bruising as possible should be avoided as the broken epidermis allows rot-germs to enter.

EARLY BLIGHT.

This disease is caused by the growth of the fungus *Alternaria solani* in the spots on the leaves. It appears before or about the time the tubers begin to form, or when anything else lowers the plant's vitality, and is indicated by grayish brown spots, with faint concentric circles like target marking on the leaves. These spots gradually become larger and in ten days, half of the leaf may be brown and withered, and the rest of an unhealthy yellow color, though the stems may remain green; or the disease may progress more slowly. Of course the tubers stop growing as the leaf-surface is destroyed, and the crop is cut short. This early death of the leaves is often so common that it is thought to be the natural ripening of the vines. But when sprayed vines live many weeks longer and produce a much larger crop, the difference is readily seen.

The treatment is thorough spraying with Bordeaux mixture. A mist like spray should be put on all parts of the vine, Paris green being added to kill the insects.

The McCormack potato now much grown in Maryland seems decidedly resistant to this disease.

A bacterial disease known as black leg is common on the potato stem in Europe, but if it occurs in America it is not common.

FIG 3.—EARLY BLIGHT (FROM GALLOWAY, FARMERS BULLETIN 91, U. S. DEPARTMENT AGRICULTURE).

LATE BLIGHT AND ROT.

This is caused by the growth of the fungus *Phytophthora infestans* in leaves, stems and tubers. It is generally first seen in moist weather in summer, as suddenly appearing, dark-colored areas on the leaves, which become soft and bad smelling. It sometimes appears so suddenly and spreads so rapidly that a green field may, in two or three days, look like it had been burned over, the blighted leaves dying and leaving the bare stems. It is estimated that in New York this disease caused the loss of $10,000,000 worth of potatoes in one year. The disease may later appear in the tubers causing them to be black and brown streaked and to rot. Other diseases may cause similar affects on the tubers.

This disease is not commonly destructive in Maryland, as the summer temperature is not usually sufficiently low for a long enough time for the development of the parasite, though it has caused serious

loss in many parts of the United States since 1840, and has been destructive at times as far south as Florida, being no doubt introduced on northern seed.

The treatment is preventative spraying with Bordeaux mixture and avoiding the planting of decayed or discolored tubers, which carry the disease over winter. Deferring digging as long as possible, reduces loss from rot in storage. The average increase due to spraying for this disease for fifteen years in Vermont, is 119 bushels per acre, or sixty-eight per cent.

The investigations of Jones show that although no varieties are proof against this disease, some are much less affected by it than others. Early varieties may mature soon enough to escape the disease, but if planted late may blight worse than others. Highly nitrogenous fertilizers lower resistance to late blight. Varieties rich in starch rot less from late blight than those rich in protein. Those with red, thick, rough skin rot less than thin-skinned white varieties. Varieties with hard, rough stem and small, rough, dark-colored leaves, blight less. Some of the American varieties less subjected to blight are Dakota Red, Rust-proof, Irish Cobbler, Sir Walter Raleigh, Doe's Pride and White Beauty, and some others not so thoroughly tested that have recently been introduced.

INJURIES NOT CAUSED BY PARASITES.

The internal brown spot disease frequently noticed in the flesh of the tuber is apparently not due to parasites, and may be due to cultural conditions, being worse on light, dry soils or those lacking lime and potash. Some varieties seem more susceptible to it. It would be better to not plant potatoes so affected.

The leaves are often injured by weather conditions, and effects similar to early blight produced. Dry, hot weather with lack of water in the soil will cause *tip burn,* which is the death and drying of the leaf margins, and sometimes spots away from the leaf edge especially where punctures of flea-beetles have caused loss of water. Too deep late culture will induce it. The name *sun-scald* is applied to similar effects due to hot sunshine after a period of wet, cloudy weather.

Plants in good, well cultivated soil and sprayed with Bordeaux mixture are less liable to tip burn. Irrigation would be helpful when it could be practiced.

The leaves are frequently injured by poisoning with Paris green, applied dry, or even with water only, giving an effect resembling early blight, especially where flea-beetles occur. By using the arsenical poisons with lime-water, or better Bordeaux mixture, this injury is obviated, as well as great benefit gained from the protection against fungous diseases which the Bordeaux affords. Many farmers use Paris green alone in a very wasteful and injurious manner, and frequent cases of supposed blight are nothing but Paris green injury. One pound per acre at each spraying is enough.

Light causes a somewhat poisonous substance found also in sprouted potatoes, to develop in the outer layers of the potato; such tubers turn greenish and are strong flavored, and unfit for food.

Frozen potatoes have a sweetish flavor, due to the conversion of some starch into sugar.

NOTES ON SPRAYING POTATOES.

Many tests have shown that the best material for spraying potatoes for leaf diseases and insects, is Bordeaux mixture, containing Paris green. It may be made as follows:

Five to six pounds copper sulphate (blue stone), dissolved in twenty-five gallons of water; four to six pounds of fresh stone lime, slacked as for white-wash in twenty-five gallons of water; one to two pounds Paris green; mix thoroughly and use fresh.

FIG. 4.—MAKING BORDEAUX MIXTURE.

The useful part is the copper, the lime is added to prevent its injuring the foliage. The best mixture is that which settles out most slowly. It is best made by taking the cold diluted milk of lime and copper sulphate solutions and pouring them together through a strainer into the sprayer, as shown in figure 4. The Paris green can be added at the same time.

Properly made Bordeaux mixture is of a brilliant sky-blue color, or lighter as more lime is added. If the lime is poor it will have a greenish cast. If there is insufficient lime in the mixture it may injure the foliage. A test of this can be made by dropping a little yellow prussiate of potash (very poisonous) into the mixture. If the drops turn reddish brown, add more lime until the test repeated shows no change. A considerable excess of lime will do no harm and is necessary for spraying some sensitive things like peach foliage. Blue litmus paper can also be used as a test; it turns red if there is not enough lime in the mixture.

When spraying is done on a large scale "stock solutions" of the copper sulphate and lime should be made up by adding one pound of lime to each gallon of water in the lime stock barrel, and one pound of copper sulphate to each gallon in the copper sulphate stock barrel. These will keep indefinitely if not allowed to evaporate, and the mixture can be easily made by taking as many gallons of each as the formula calls for pounds, and dilute and pour together as before.

If one has a suitable water supply pipes and faucets to barrels on an elevated platform can be arranged to save labor of handling the liquids. They can also be piped together into the sprayer and thus mixed if always first diluted.

The ordinary barrel pump, costing about fifteen dollars, is one of the best arrangements for potato spraying, one man pumping and driving the cart or wagon, and two others working the nozzles. Or with a little more expense a set of pipes, with nozzles attached, in the proper position to spray four rows at a time, can be arranged so that one man can do all the work, though less effectively; for larger fields geared pumps of similar structure to the last mentioned are used, and the labor is done by the horse, but they are more expensive ($60 to $75), and do less careful work. It is essential to good work to have a pump and nozzle that will make a fine mist, and not simply sprinkle the plants.

Spraying probably would not be very profitable here on early potatoes. Wherever late blight does damage it would pay well. Three years tests of spraying potatoes at this Experiment Station, showed an average increase of fifty-two per cent. on the sprayed fields, spraying three or four times from June to September. On late varieties when no blight was present, experiments in New York show a net profit of $11 per acre, when potatoes were only twenty-five cents per bushel.

It will cost $4 to $6 per acre to give five applications of the spray per season to potatoes. This includes labor for man and team and wear on sprayer, labor being estimated at seventeen and one-half cents per hour, which is more than is usual in this State. Here we could usually spray at a cost of less than one dollar per acre for each spraying. Labor is the principal expense, after the spraying outfit is secured, as the materials cost comparatively little.

As a general rule commence spraying when the plants are six to eight inches high, and give four to five sprayings at intervals of about two weeks. When the blossoms begin to come the plants should be kept covered with Bordeaux mixture until they have completed their growth.

The application of Bordeaux mixture aside from preventing parasitic diseases, and repelling flea-beetles causes the plants to make a better growth, probably by protecting the foliage from the intense summer light and heat, and so is of value even when no disease is present.

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CONTENTS.

IRISH POTATO DISEASES.

	PAGE
General Conditions of Health	63
Seed with Reference to Health	64
Scab	66
Rhizoctonia	67
Dry Rot	67
Brown Rot or Wet Rot	68
Early Blight	68
Late Blight and Rot	69
Injuries not Caused by Parasites	70
Notes on Spraying Potatoes	71
Making Bordeaux Solution	71